

Effect Flipped Classroom Method, achievement motivation, self – efficacy and gender on Secondary School Students’ Interest in Physics in Calabar Education Zone, Nigeria

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ABSTRACT: *The study investigated the "Effect Flipped Classroom Method, achievement motivation, self – efficacy and gender on Secondary School Students’ Interest in Physics in Calabar Education Zone, Nigeria." In pursuance of this purpose, two research questions were asked from which two hypotheses were formulated. The study adopted the pre-test-post-test, quasi-experimental, non-randomized design. The population of the study consisted of 1,430 senior secondary two science students from four secondary schools in Calabar Education Zone of Cross River State. A sample size of 109 science students from the four intact classes, drawn from 84 secondary schools in two local Government Area in Calabar Education Zone, using stratified random sampling and purposive sampling techniques was used. The study adopted quasi experimental, pre -test, post –test, non- randomized design. The study used three (3) instruments: (1) Students’ self-efficacy questionnaire (SEQ) and (2) Students’ Achievement Motivation (SAMQ) and (3) Students’ Interest questionnaire (SIQ) for data collection. The three instruments were validated and the reliability determined using Kuder-Richarson formula (K-R₂₀) method and Cronbach-coefficient and the calculated reliability coefficient for self-efficacy was 0.8167, achievement motivation was 0.616 and interest was 0.762. Data analyses were carried out using the Two -way Analysis of Covariance (ANCOVA) and Multiple Regression Analysis. All the hypotheses were tested at 0.05 level of significance. The following findings were obtained: There is no significant difference in male and female students’ academic achievement in Physics when taught Physics with flipped classroom and conventional methods. The joint effects of teaching methods, achievement motivation, self-efficacy and gender on the students’ interest, academic achievement and retention in physics was significant. The result of finding in this study also showed that, the calculated F value of the regression ANOVA is statistically significant at .05 significance level. This means that at least one of the independent variables has significant effect on students’ interest in Physics. The multiple correlation coefficient of the variables, R, is 0.781, which is relatively high means that 61% (i.e. R² x 100%) of the variance of students’ interest in Physics can be accounted for by instructional method, students’ achievement motivation, self – efficacy and gender as well as pretest of students’ interest. The major implication in this study is that the interest and academic achievement of science students was improved through flipped classroom method. Based on the findings, it was recommended that Physics teachers*

and students should be exposed to Flipped classroom through seminars or trainings to improve their inputs during teaching/learning and teachers should vary their instructional approach by using flipped classroom method as against consistent use of conventional method.

Keywords: physics, flipped classroom, achievement motivation, gender, self-efficacy, interest, academic achievement, retention.

INTRODUCTION

According to Sani (2012), physics is a branch of science that deals with energy and matter and their interactions. Physics is the branch of natural science that deals with the behavior and properties of matter, energy and their relationship. It is sometimes referred to as the science of measurement (Sani, 2012). Physics remains the fundamental science among other science subjects, because many of the tools on which scientific and technological advancement depends on, are the direct products of Physics. The knowledge and principles of Physics had led to sustainable development in the area of industrialization as well as improvement of wellbeing of human race.

Apart from the general knowledge of physics principles which enhances daily living in the modern society, students are required to obtain a pass at credit level as one of the requirements, to be eligible for admission into various science courses like Mechanical Engineering, Electrical Engineering, medicine, Electrical Electronics, Pure physics and many more (Khan, Quarashi, Hussain & Hayee, 2005). In spite of the usefulness and numerous applications of Physics, academic achievement of students in physics has continued to be generally low for the past years (West African Examination Council (WAEC), 2022). National Examination Council (NECO), (2011) chief examiner also reported that core subjects (Physics inclusive) recorded mass failure. Therefore, the percentage of students' academic achievement was observed to be low.

According to Williams (2018), talking about academic performance is often associated with students' GPA. However, academic performance can also be regarded as an accomplishment of scientific achievements and skills, impressive test scores, extracurricular achievements, students' ability to lead if assigned to. Academic achievement, according to Ghanney and Aniagyei (2014), is something capable of achieving by students when they are tested with what has been taught. The academic performance here focuses more on intellectual capacity. According to Siqueira and GurGe-Giannetti (2011), poor academic achievement can also be interpreted as a result of school achievement below expectations. The explanation from different scholars maintained that poor academic achievement refers to something measured, but does not meet the expectations or standards of achievement.

Assefa, Ohijeagbon, Negash, and Melese, (2008) identified lack of interest as one of the major areas of problems that physics students are facing. Meanwhile, because of such low levels of interest, the number of students studying sciences during their senior school years becomes few and this in turn leads to a shortage of science students in various disciplines. (Forgasz, 2006). Students' interest towards learning science subjects like physics, chemistry, Biology and Mathematics have long been a common concern among educators. Students' interest towards science has been considered an important factor influencing

participation and success in the science subjects. The engagement of students in the process of learning tasks is considered higher when the learner is interested in that task. Interest is an enduring characteristics expressed by a relationship between a person and a particular activity or object (Elliot, Kratochwill, Littlefield, & Travers, 2000).

Self-efficacy has been observed as one of the factors that influence academic achievement of students in science, most especially physics ([Ramnarain & Ramaila, 2017](#)). The construct of self-efficacy reflects an optimistic self-belief, a belief that one can perform novel or difficult tasks, or cope with adversity in various domains of human endeavor (Bandura, 1997b). Self-efficacy is the individual's confidence on his competences to execute the level of energy required to surpass in life. Self-efficacy is a person's sureness or the capacity for execution to achieve the goals and accomplish tasks. It is actually the confidence that individual has with the help of which he can cope in different situations successfully. Self-efficacious person is one who strives to reach and achieve the goals. He operates with intelligent guesses to perform the work and derive the results and conclusion (Aamna, Irshad & Shah, 2020). High self-efficacious students fix higher goals to achieve and are able to face the complex situation and to work in a stress compared to the pupils with low self-efficacy, as they will be unable to do the same (Ahmad & Triantoro, 2013).

Findings from researches showed that determination is one of the attributes of students with high self-efficacy (Zajacova, Lynch & Espenshade, 2005). Students with this quality will continuously work by finding out effective ways to control difficulties in achieving their goals, while students with low self-efficacy will discontinue because of inability to remove barriers in achieving and learning (Ormroid, 2000). Nghambi (2014) and Afriani (2020) stated that, non-use of appropriate teaching methods, inadequate supply of teaching materials and learning processes, insufficient teacher training, inappropriate government policies and lack of care from parents for their children are several factors causing students to have poor academic achievement.

In recent years, educational systems in many countries have experienced a tremendous and rapid change. This change is as a result of teaching and learning strategies being structurally modified (Brien, 2005). The modification leads to the development and introduction of new teaching and learning method or strategies. Some of these methods allow the instructors and learners to focus on their roles, and most strategies are student- centred while some are teacher-centred. One of such modern strategies is the Flipped Classroom Method (FCLM).

Mull (2012) defined flipped classroom method as that in which learners prepare themselves for the lesson by watching and listening to the videos via media. Clark-Ibanez and Scot (2010) defined flipped classroom method as a pedagogical approach that employs blended knowledge. It is a method where learners are provided with the contents through a video form, to be used outside the school environment or at home (Robb & Rudy, 2012). Flipped classroom method aims at making the learning and teaching processes active and thereby giving the learner opportunities to use his or her knowledge or idea in the classroom. However, flipped classroom method enables students to be acquainted with new information with the aid of different technological tools that have been prepared and distributed by teachers and other educators. For example, a teacher prepares a video that contains some physics concepts such as simple machines and electricity using Teacher Youtube or Adobe presenter. This video which may last for about

20 and 40 minutes affords students first-hand learning even before physical contact with the teacher and classmates

Theoretical background

This study is anchored on the Constructivist theory by Bruner (1966) and Constructivist theory by Bruner (1966). A major theme in Constructivist theory by Bruner is that, learning is an active process in which learners construct new ideas or concepts based on their current or past learning experiences in the new learning situations. According to Bruner (1966), learners select and transform information, construct hypotheses, and make decisions, based on their cognitive structure to do so. The basis of this theory is that, learners do not only comprehend new information, but they can use their experience with the new knowledge to make sense of the information they receive as they expand their understanding and knowledge.

This theory claims that learners learn best when they are building knowledge by individually and socially constructing meaning as they use their past experience to access new knowledge.

Constructivist theory by Bruner (1966) also asserted that in the classroom, teachers' role as an instructor is to present the materials to be learnt in such a way that, the learner can assimilate (Bruner, 2009). Teachers are also to engage students actively during learning and to assist them in whatever they are doing. Bruner (1966) posited that, constructing of new knowledge is achieved when students can explore a problem, attempt to solve it, and adjust to develop new solutions. Bruner (1966) states that a theory of instruction should address four major aspects:

1. Predisposition towards learning,
2. The ways in which a body of knowledge can be structured so that it can be most readily grasped by the learner.
3. The most effective sequences in which to present material.
4. The nature and pacing of rewards and punishments.

Good approaches for organizing knowledge should result in simplifying, generating new propositions, and increasing the manipulation of information. The relevance of this theory in this work is that, students should be provided with video material that matches with the concept in the content. Therefore, learning is very effective when learners are given opportunity to construct their own ideas in a given learning situation. This theory is also relevant in this study because learners are actively involved in the learning process, and physics students are allowed to actively discuss and develop their own ideas after watching the video provided by the teacher. Teachers in the classroom ought to motivate students to discuss about what they have learned as well as students being allowed to have their own input during discussion section. In this study, students in the classroom are treated as specific entity and given the privilege to work as individuals and as group.

Statement of the problem

Low students' interest and academic achievement of science students in secondary schools has been an unresolved issue in Calabar Education Zone and Cross River State as a whole. The academic achievement and interest had witnessed a deplorable trend in the past decade. This problem of poor students' academic interest and achievement in physics persistently occurs and become worse as years elapses. The problem of this low interest and academic achievement of physics students had long been observed by different research studies and examination bodies like West African Examination Council

(WAEC) and National Examination Council (NECO). Observations and reports from these examination bodies showed that, a high percentage of secondary school students continue to perform poorly in physics examinations. Considering the analysis of the results of the examination conducted by the WAEC in Nigeria in May/June 2018-2022, out of 24,754 candidates who sat for Physics, only 10,505(42.44%) had high grades while 14,249(57.56%) had low grade in physics. Empirical research reports indicated that, lack of self- efficacy, low achievement motivation, gender and persistent use of the lecture method of instruction has been identified as some of the reasons for low interest of science students in secondary schools over the years.

Although, various steps had been taken by government, teachers, school authority and the parents in an attempt to surmount this problem of low interest and academic achievement of science students in our schools, but the efforts have only yielded minimal results. Moreover, it is the belief of the researcher that if flipped classroom method is deliberately adopted in teaching physics, it will enhance the interest and achievement of physics students in secondary school. Therefore, the study is designed to investigate Effect Flipped Classroom Method, achievement motivation, self – efficacy and gender on Secondary School Students’ Interest in Physics in Calabar Education Zone, Nigeria.”

Significance of the study

The findings of this study may be significance to students, teachers, school curriculum planners, government and researchers. Students of Faculty of Education at undergraduate and graduate levels may also benefit from the findings of this study. The anticipated results may encourage students to see the need of applying flipped classroom method in their learning process.

The outcome of this findings in this study may serve as empirical evidence on the effects of using flipped classroom method in teaching physics concepts among physics teachers. It may also provide the basic guideline to physics teachers in general, on how to deploy flipped classroom method in teaching physics concepts. This study may also help physics teachers and other subject teachers to vary their teaching methods. Most especially, teachers in secondary school level may see the findings of this study as a relevant document that may improve their methods of teaching physics

The results obtained in this study may provide vital information that will help the curriculum planners to see the need of improving the instructional strategy. The results of finding may serve as a feedback to the curriculum planners. Results from this study may also equip them with relevant information on teachers’ training with emphasis on exposing teachers to acquire the necessary skill on the use of flipped classroom method in teaching physics.

The findings of this study, if properly disseminated may help government to make appropriate appraisal of her polices with respect to the recruitment and in-service training of physics teachers for secondary schools. Finally, the results of finding may provide information to researchers on the state of science classroom, and those seeking similar information on the phenomenon under investigation either on the broader scope or in other locations, could see the findings in this study useful.

Purpose of the study

The purpose of this study investigated the Effect Flipped Classroom Method, achievement motivation, self – efficacy and gender on Secondary School Students’ Interest in Physics in Calabar Education Zone, Nigeria.” Specifically, the study sought to determine:

1. The difference in mean interest ratings of male and female science students taught with flipped classroom method.
2. The joint effect of instructional method, achievement motivation, self – efficacy and gender on students’ interest in science when taught with flipped classroom method and conventional method.

Research questions

The following questions were generated to guide the study

1. What is the difference in mean interest ratings of male and female science students taught with flipped classroom?
2. What is the joint effect of instructional method, achievement motivation, self – efficacy and gender on students’ interest in science when taught with flipped classroom method and conventional method?

Statement of hypotheses

On the basis of the research questions posed, the following null hypotheses were formulated to guide this study.

1. There is no significant difference in mean interest ratings of male and female science students taught with flipped classroom method and conventional method.
2. There no significant joint effect of instructional method, achievement motivation, self – efficacy and gender on students’ interest in science when taught with flipped classroom method and conventional method.

LITERATURE REVIEW

Gender and students’ interest in science

Jegade (1990) in a survey of junior school boys and girls on the influence of gender on interest in science argued that, there is a gender gap concerning students’ interest and achievement in science. Both male and female students perform well in science in the junior secondary school but by the time they begin their course of study in the polytechnics and universities the female students do not retain their interest in science.

Study conducted by Godpower-Echie and Sopuruchi (2017) to examined the influence of gender on interest and achievement of integrated Science students in Obio Akpor local government area of Rivers State. Two research questions and two hypotheses were raised, the population comprised of all secondary school students in the local government area and a total of 600 students took part in the study. Two instruments were used to collect data: the test scores and a interest scale. Mean, standard deviation and t-test were used to analyze the data. The results of findings showed that gender has a significant influence on the interest, but does not have a significant influence on achievement of Integrated Science students.

Another conducted by Allahnana, Akande, Vintseh, Usman, Alaku and Monica (2018) to assess gender and interest in mathematics achievement in Keffi Local Government Area of Nasarawa State, Nigeria. Three objectives were raised in relation to three hypotheses. The study adopted ex-post facto research design. The target population for this study consisted of 3548 SS 3 students' in 2017/2018 academic session from 24 Senior Secondary Schools. The population was made up of 2,705 male and 843 female students. A sample size of 361 SS 3 students which involved 182 male and 179 female students was

used. The researchers developed a single Performa as instrument for data collection. Descriptive statistic of mean and standard deviation were used to answers research questions while inferential statistics of biserial correlation was used to test the formulated hypotheses at the 0.05 level of significance. The study found that male students excel in mathematics achievement more than their female counterparts and that male students have interest in mathematics than female students that is to say; there is significance relationship between male and female and interest in mathematics.

Effect of instructional method, achievement motivation, self – efficacy, gender and students' interest Self-efficacy and interest have frequently been identified as important motivational factors that influence learning and performance (Eccles & Wigfield, 2002). A study conducted by Markku and Tapola (2007) on self-efficacy, interest and task performance to examine whether there is a relationship between self-efficacy and students' interest in task performance. To achieve this, 100 participants from ninth-grade students, were repetitively asked to rate their efficacy judgments and interest while they were working on a complex problem-solving task. The results from a series of latent growth curve methods showed a significant overall increase in students' self-efficacy during the task. Result also showed that, interest and self-efficacy were positively correlated.

A study conducted by Multon, Brown and Lent (1991) to determine students' self-efficacy on students' interest in mathematics. The sample for the study consisted of 138 participants (53 males, 85 females) of introductory psychology students. Three research instruments titled Mathematics Self-Efficacy Scale, Mathematics Self-efficacy Index and Mathematics Course Interest Scale were used for data collection. Data were analyzed, and result of the findings showed that, self-efficacy predicted students' interest.

A research carried by Özyürek (2005) to determine whether there is a relationship between self-efficacy, interest and mathematics weighted majors' preferences. The study used 590 participants (109 females, 113 males), tenth (76 females, 115 males) and eleventh (90 females 87 males) grade high school students enrolled in state and private high schools in a southern city of Turkey. The instruments used in the study for data collection were, "Measurement of Information Sources of Math-Related Self-Efficacy", Math Related Self-Efficacy Measurements, Mathematics Interest Measurement and instruments for measuring math-weighted goals. Results from the findings indicated that, all sources but vicarious learning predicted self-efficacy. Also, sources had a significant indirect impact on interest through math related self-efficacy.

Moreover, Luzzo, Hasper, Albert, Bibby and Martinelli (1999) conducted a research on career undecided college students. The aim of the study was to evaluate the effects of performance accomplishments and vicarious learning experiences on math/science self-efficacy and career interests, goals and actions. The participants of the study were 94 freshmen (55 females, 39 males) at a large public university. Data were collected using four research instruments titled: Academic Achievement Test mathematics score, Math/Science course self-efficacy scale, self-efficacy for technical/scientific fields scale, math/science occupational self-efficacy scale and career interests rating scale. Data collected were analyzed and result from the findings indicated that, there was a statistically significant relationships between math/science self-efficacy and measures of career choice interests and actions.

Interest is very important factor when it comes to learning, interest is cause when a person become interested in a particular activity or when one is likely to become more deeply involved in such activity.

Interest is a subjective feeling of concentration or curiosity over something. Interest plays an important role in learning and teaching processes.

A research conducted by Jerald and Jennifer (2020) on Parental Motivation and Students' Interest. The study assessed the parental motivation and students' interest. The research was a quantitative descriptive correlation design which explores the relationship between parental motivation and students' interest in their studies using statistical analyses. A sample size of 249 respondents which consisted of all the Senior High School particularly Grades 11 and 12 was used. Students' interest in their studies showed that, most of the students in Senior High School Department often have an interest in their studies. The result of the study showed that, the null hypothesis was rejected. Therefore, there was an association between parental motivation and students' interest in their studies.

A study conducted by Mohd, Othman, Tajularipin and Nuurzatulshima (2019) on the implementation of flipped classroom teaching strategies in order to improve academic achievement and interest of chemistry students was carried out at the secondary schools in Hulu Langat District, Selangor in Malaysia. The sample size for study was 32 chemistry students, 17 boys and 15 girls. The study used two types of instruments namely, the achievement test, which involve in the pre-test and the post-test and the survey to measure the level of interest among students towards flipped classroom teaching strategies. Data was collected and analyzed using descriptive and inferential statistics (pair sample t-test) to determine the value of mean, standard deviation and the difference of mean scores between the pre-test and the post-test. Results from finding showed that, there was an improvement in the post – test with the mean value of 66.56 (SD= 3.08) compared to pre –test with the mean value of 51.72 (SD = 4.11). There was a significant difference of mean scores ($t = - 23.914$, $df = 31$, $p < 0.05$) between pre-test and post-test. The level of interest among students towards the flipped classroom strategies showed a medium high score (mean =3.73). This finding also showed that, flipped classroom strategies could enhance the academic achievement as well as students' interest among SS I chemistry students. A research have shown that flipped classroom technique has the potential of increasing students' interest in learning and meeting their needs (Phillip & Traino, 2014).

A research work conducted by Ernest (2018) on the effects of flipped classroom on learning management system and face-to face learning environment on students' gender, interest and achievement in accounting, in Enugu and Anambra states in Nigeria. The study adopted a quasi-experimental, a non – equivalent and control group research, with the sample size of 168 first year undergraduate students, 96 students were used for the experimental group and 72 for the control group. Two instruments titled Element of Account Achievement Test (EAAT) and Interest Inventory Questionnaire (IIQ) were used for data collection. The EAAT consists of 53 objective test items while IIQ consisted of 25 items questionnaire, which was validated by measurement and evaluation experts. Data were collected using the two instruments, and analyzed using descriptive statistic of mean and Analysis of Covariance (ANCOVA). The result from the finding showed that, the means scores on interest inventory questionnaire from the experimental group and control group before and after treatment differs. The result indicated that, the experimental group who were taught elements of accounting using flipped classroom on learning management system (LMS) recorded a mean interest of 2.16 and 4.50 with the standard deviation of 0.83 and 0.56 for pre-test and post-test on the interest inventory and mean gain was 2.34 while the control group who were taught using face-to face approach had a mean rating of 2.00 and 1.73 with standard deviation of 0.75 and 0.63 for pre-test and post-test on the interest inventory. The group also recorded -0.27 mean gain on interest. From the finding, the researcher inferred that, flipped

classroom on Learning Management System has the capacity of increasing students' interest level in learning of Accounting. The result also showed that, there was a significant difference in interest level of the two groups.

METHODOLOGY

Research Design

This study adopted the quasi-experimental pre-test, post-test, non-randomized design. This is because the study involves the manipulation of the independent variable (teaching methods) in order to determine its impact on the dependent variables.

Area of Study

The study was conducted in Calabar Education Zone of Cross River State which is one of the three Education Zones in Cross River State, Nigeria.

Population of the Study

The population of study consisted of 1,430 senior secondary school two (SSII) physics students in Calabar Education Zone. There are 84 secondary schools in the seven Local Government Area in Calabar Education Zone, and the 84 secondary schools comprises of 810 male and 620 female physics students, making it total of 1430 senior secondary two (SSII) physics.

Sampling technique

A stratified random sampling technique was used to select two Local Government Areas from the seven (7) LGA in Calabar Education Zone. From the two LGAs selected, four schools out of 84 schools in Calabar education zone were selected using purposive sampling technique. The selection of the four schools (school A, B, C and D) was based on the following criteria: (1) The school must have electricity, in order to power the electronic devices (Projector, and lap-top before and during the discussion class. (2) The selected school must have up to senior secondary (SS2). Then from the schools selected, three intact classes in schools A, B and C were used as experimental group while one intact class in school D was used as control group. This is because the control is used in checking the experimental group.

Sample

The sample for the study consisted of 109 science students (57 for experimental group and 52 for control group) selected from the four intact classes selected from the four (4) schools.

Instrumentation

The study used three (3) instruments: (1) Students' self-efficacy questionnaire (SEQ) and (2) students' Achievement Motivation (SAMQ) and (3) Students' Interest questionnaire (SIQ) for data collection. PAT which was used to collect data on academic achievement and was designed to measure students' achievement in physics and students' retention respectively. PAT consists of sixty (60) items each with multiple choice questions and with four Options A, B, C and D. It has one correct option and three others as detractors. While Students' self-efficacy questionnaire (SEQ) Students' Achievement Motivation Questionnaire (SAMQ) and Students' Interest questionnaire (SIQ) was designed to measure students' self-efficacy, Students' Achievement Motivation and interest in physics respectively. SEQ, SAMQ and

SIQ consists of 15 items each, and was used to measure students' efficacy, achievement motivation and interest in physics. Students' self-efficacy questionnaire (SEQ) and SAMQ is based on four point Scale of Strongly Agreed (SA), Agreed (A), Disagreed (D) and Strongly Disagreed (SD) and Students' interest questionnaire (SIQ) is based on four point Scale of Always (A), Most times (MT), Sometimes (ST) and Not at all (NA).

Validity of the Instruments

In this study, face and content validity was established. The three instruments were validated by three experts from test and measurement and four physics teachers from four selected secondary schools.

Reliability of the instrument

Cronbach-coefficient Alpha (α) method was used for determining the reliability of SEQ, SAMQ and SIQ because the scores generated are not polytomous (Joshua, 2012). The calculated reliability coefficient for self-efficacy was 0.8167, achievement motivation was 0.616 and interest was 0.762. respectively.

Procedure for Data Collection

Data was gathered using three instruments namely; Students' self-efficacy questionnaire (SEQ), students' Achievement Motivation (SAMQ) and Students' Interest questionnaire (SIQ). The sampled schools were visited by the researcher to seek permission from the school authorities and to select one physics teacher from each school who was used for the study. At the commencement, SEQ, students' Achievement Motivation (SAMQ) and students' interest questionnaire (SIQ) were administered to both the control and the experimental groups to determine the pre-test. After this, the experimental and control group received four weeks teaching from the physics teachers selected to assist in the study.

The experimental group was taught using flipped classroom method. In this method, the researcher created a video and sent to the subjects through WhatsApp group platform. After watching the videos, the students were asked to prepare their questions for class discussion. Thereafter, the researcher assistant gathered the subjects in experimental groups into smaller group based on the class size. The researcher then requested the students to discuss and ask their questions based on the video watched. The researcher then fielded all questions by answering them in the classroom. At the end of the treatment, a post-test was then administered on both groups with same Students' self-efficacy questionnaire (SEQ), Students' Achievement Motivation (SAMQ) and students' interest questionnaire (SIQ) containing 15 items each. The SEQ, SAMQ and SIQ were collected from the respondents that same day arranged and marked.

Data Analysis / Discussion

The data collected was analysed using IBM statistical package for the social sciences (SPSS) version 20. The results are presented and interpreted hereunder for each research question and hypothesis. All the hypotheses were tested at .05 significance level.

Research question 1

What is the difference in mean interest ratings of male and female science students taught with flipped classroom?

The research question was answered with the mean and standard deviation of the pretest and posttest interest scores of male and female students in the two treatment groups. The results are shown in Table 1.

The results on Table 16 indicate that the mean gain scores of male and female students taught with flipped classroom method are in each case negative and more than that of those taught with the conventional method. The gain scores for female student in both treatment groups are higher than that male students. Invariably, male and female students differ in their interests in Physics when taught with flipped classroom and conventional methods.

TABLE 1

Mean and standard deviation of the interest ratings in physics of male and female Physics students in the two treatment groups

Treatment	Gender	Pretest Mean	S	Posttest Mean	S	Gain score
Flipped classroom method	Male	47.600	8.602	44.840	9.88	-2.760
	Female	48.281	6.213	45.500	6.89	-2.781
Conventional Method	Male	37.955	10.083	36.682	9.27	-1.273
	Female	35.900	10.073	35.967	9.97	0.067

Research question 2

What is the joint effect of instructional method, achievement motivation, self – efficacy and gender on students' interest in physics when taught with flipped classroom method and conventional method?The research question was answered with the multiple correlation coefficient of the independent and dependent variables. This is shown in Table 2.

The multiple correlation coefficient of the variables, R, is 0.781, which is relatively high. This means that 61% (i.e. $R^2 \times 100\%$) of the variance of students' interest in Physics can be accounted for by instructional method, students' achievement motivation, self – efficacy and gender as well as pretest of students' interest.

TABLE 2

Multiple correlation coefficient of the variables

R	R Square	Adjusted R Square	Std. Error of the Estimate
.781	.610	.591	6.148

Hypothesis 1

There is no significant difference in mean interest ratings of male and female science students taught with flipped classroom method and conventional method. The hypothesis was tested with two-way ANCOVA statistic using pretest of students' interest in Physics as covariate. Levene's test of equality of error variances indicate a significant F value ($F=19.234, p=.000$), which means the error variance of the dependent variable across groups is equal. So the test statistic can be used. The results of data analyses are shown in Table 3.

As shown in Table 3, the calculated F value for the interaction of treatment and gender is 0.347 which is not statistically significant at .05 level ($p > .05$). This means that there is no significant difference in male and female students' interest in physics when taught physics with FLCM and CM. Therefore, the null hypothesis is not rejected.

TABLE 3

Summary of the 2-way ANCOVA of influence of gender on students' interest in physics when taught with flipped classroom and conventional methods

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Method	5993.708 ^a	4	1498.427	38.988	.000	.600
Intercept	511.596	1	511.596	13.311	.000	.113
Pretest of interest	4112.055	1	4112.055	106.993	.000	.507
Treatment	.012	1	.012	.000	.986	.000
Gender	7.671	1	7.671	.200	.656	.002
Treatment * Gender	13.354	1	13.354	.347*	.557	.003
Error	3997.044	104	38.433			
Total	196349.000	109				
Corrected Total	9990.752	108				

* $p > .05$

The calculated F value of the regression ANOVA is statistically significant at .05 significance level. This means that at least one of the independent variables has significant effect on students' academic achievement in Physics. The regression statistics shown in Table 35 indicates the variable(s). From Table 6 the values of the standardized (and even the standardized) regression coefficients, pretest has the highest effect on students' academic achievement, followed by self-efficacy, treatment, achievement motivation and lastly gender, in descending order of magnitude. However, only the effect of pretest of interest is statistically significant ($p < .05$).

TABLE 4

First – order inter – relationships among the independent and dependent variables

Variables	Interest	Treatment	Gender	Achievement Motivation	Self-efficacy	Pretest
Interest	1	-.422*	-.055	.131	.286*	.773*
Treatment	.000	1	.016	-.331*	-.498*	-.545*
Gender	.284	.436	1	-.132	.164	-.038
Achievement Motivation	.087	.000	.085	1	.329*	.091
Self - efficacy	.001	.000	.044	.000	1	.264*
Pretest	.000	.000	.346	.174	.003	1

* $p < .05$

TABLE 5
Summary of the regression ANOVA of the variables

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Regression	6097.714	5	1219.543	32.266*	0.000
Residual	3893.039	103	37.796		
Total	9990.752	108			

*P < .05

TABLE 6
Regression statistics of the variables

Independent variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.316	7.091		.468	.641
Treatment	1.333	1.609	.070	.829	.409
Gender	-.749	1.236	-.039	-.606	.546
Achievement Motivation	.050	.079	.043	.631	.530
Self efficacy	.112	.078	.108	1.451	.150
Pretest of Interest	.723	.069	.777	10.512*	.000

*p < .05

DISCUSSION OF FINDINGS

The findings of this study is discussed as follows:

Gender and students' interest in science

The result of hypothesis eleven shows that, there is no significant difference in mean interest score of male and female physics students taught with flipped classroom method and conventional method.

The results in this study showed that, the male and female students differ in their interests in Physics when taught with flipped classroom and conventional methods, and even though gain scores of male and female students taught with flipped classroom method are in each case negative and more than that of those taught with the conventional method, the difference is not significant. In addition to the effects of treatment of both flipped classroom and conventional approaches are not significantly relevant at improving the students' achievement in physics. Although the general belief is that gender can influence performance of students.

Further explanation on the reason why the results showed a negative gain scores and insignificant difference, could be because of the area of study. In addition the students' health could have been one of factors that might have caused the students' achievement scores in both groups to drop.

The result of findings in this study do not affirm the assertions of Jegede (1990) who posited that, there is a gender gap concerning students' interest and achievement in science. Contrary to the findings in this study, Godpower-Echie and Sopuruchi (2017) found that, gender significantly influence the interest of students.

The findings in this study do not agree with the result of findings obtained from a research conducted by by Allahnana, Akande, Vintseh, Usman, Alaku and Monica (2018), who established that, male students excel in academic achievement more than their female counterparts and that male students have interest in science than female students' counterpart.

The reason for difference in the present results on this study and that of Jegede (1990), Godpower-Echie and Sopuruchi (2017) and Allahnana, Akande, Vintseh, Usman, Alaku and Monica (2018) may be because of the fact that, this study uses physics as a subject while other studies were conducted in mathematics and chemistry. Sample size could be another reason for difference in the results of findings in the study. Research area may be considered as one of the factors that contributes to the inconsistency of results. It is noted from the literature review of the present study, the reviewed studies were conducted outside Calabar Education Zone in Cross River State and even outside Nigeria.

Joint effect of instructional method, achievement motivation, self – efficacy and gender on students' interest

The discussion in this section is considered hypothesis thirteen (13). These are presented in Table 37. The multiple regression that served as a tool for analyzing the data in this study has proven that from the values of the unstandardized (and even the standardized) regression coefficients, pretest has the highest effect on students' academic achievement, followed by self-efficacy, treatment, achievement motivation and lastly gender, in descending order of magnitude. However, only the effect of pretest of interest is statistically significant ($p < .05$).

The result of finding in this study also showed that, the calculated F value of the regression ANOVA is statistically significant at .05 significance level. This means that at least one of the independent variables has significant effect on students' **interest** in Physics. The multiple correlation coefficient of the variables, R, is 0.781, which is relatively high means that 61% (i.e. $R^2 \times 100\%$) of the variance of students' interest in Physics can be accounted for by instructional method, students' achievement motivation, self – efficacy and gender as well as pretest of students' interest.

Moreover, from the result of findings in this study, only the relationship between (the following pairs of variables) Interest/Treatment, Interest/self-efficacy, Interest/Pretest, Treatment/achievement motivation, treatment/Pretest, achievement motivation/self-efficacy and self-efficacy/pretest were statistically significant ($p < .05$). All other relationships between pairs of variables are not statistically significant ($p > .05$).

This result is supported by Akoko (2010) who posited that the higher the level of interest in learning, the more positive result obtained from academic achievement. This implies that, the use of flipped classroom method enhances students' interest.

CONCLUSION

As previously stated, the major purpose of the study was to investigate the Effect Flipped Classroom Method, achievement motivation, self – efficacy and gender on Secondary School Students' Interest in Physics in Calabar Education Zone, Nigeria.” Consequent upon the results and findings of this study, it was hereby concluded that, the joint effects of teaching methods, achievement motivation, self-efficacy and gender on the students' interest, academic achievement and retention in physics was significant.

The gain scores for female student in both treatment groups are higher than that male students. Invariably, male and female students differ in their interests in Physics when taught with flipped classroom and conventional methods. It is therefore concluded that, to enhance higher the interest of students in Physics, flipped classroom method should be adopted.

Recommendations

Based on the results of the data analysis, the following recommendations are made.

1. Physics teachers should be exposed to FLCM through seminars or trainings to improve their inputs during teaching/learning.
2. Physics teachers should vary their instructional approach by using FLCM as against consistent use of LM. This will improve the academic achievement of Physics students.

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